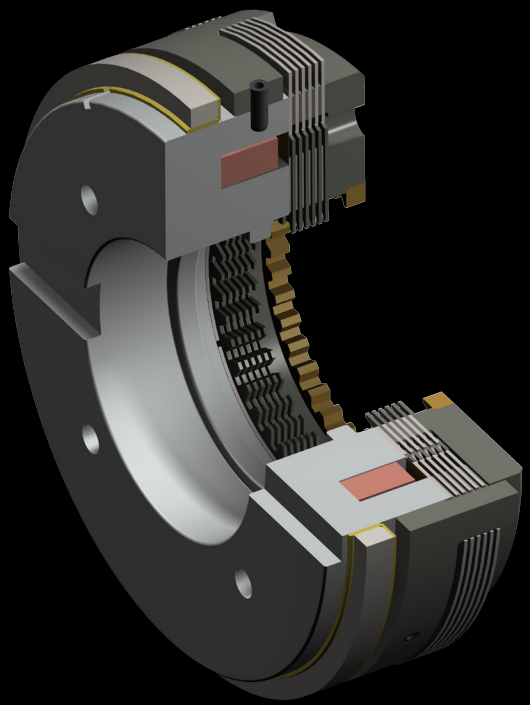
Mönninghoff

Electromagnetic multiple-disc clutch Type 502



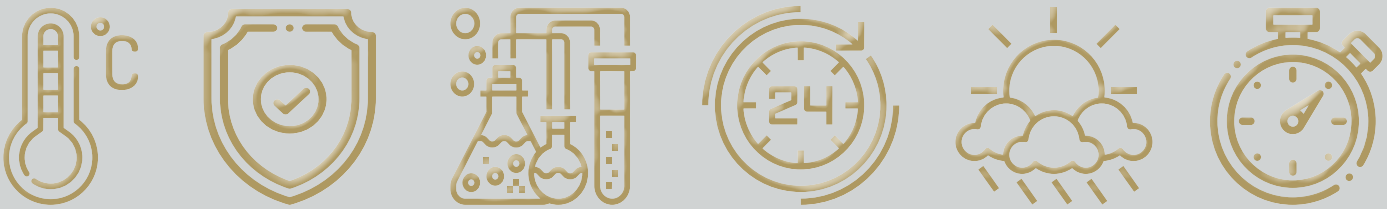
CHAIN & DRIVES®
COMPLETE BEARINGS & POWER TRANSMISSION
POWER > SPEED > TORQUE

Mönninghoff

Electromagnetic multiple-disc clutch - Type 502

Characteristics and features

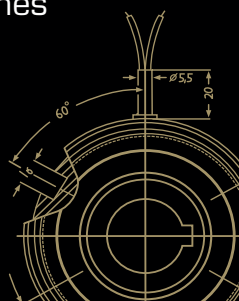
- suitable for torque transmission with increasing differential speed between the drive elements
- high torque transfer despite compact dimensions
- designs up to 1600 Nm possible
- particulary suitable for shifting operations with a high energy exchange
- negligible wear due to special friction lining
- only oil running
- maintenance free
- suitable for applications in harsh environments
- reduced shift speeds due to adapted control
- also available as electromagnetic multiple-disc brake



Mönninghoff power transmission represents an infinite variant diversity that is applied by all areas of modern mechanical engineering.

Our technologies are mostly designed to operate under extreme conditions. We offer high precision products for medical robotics, fail-proof security for aerospace technology or synchronization soultions for the packaging or printing industry.

We thus address customers who have the highest standards for their own machines or systems. To them, we can offer highly complex, application-specific solutions.



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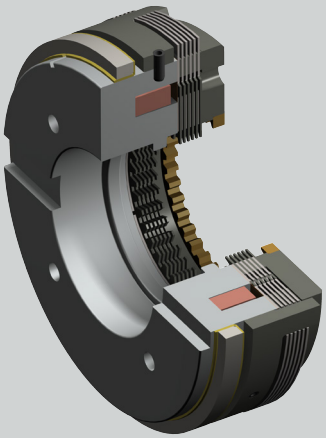
Match code

Mönninghoff multiple-disc clutches are indicated by the following match code:



502 . A . B

A clutch size

B design

Other individual characteristics:

- voltage
- bore size with keyway

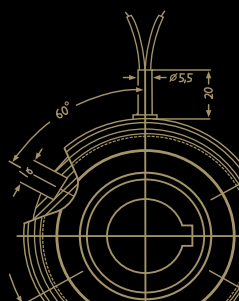
According to these characteristics, we design individual solutions concerning transmitted torque, engaging behavior or rotation speed.

Our engineers can assist with finding an application-specific clutch at any time. Together, we can develop individual and innovative solutions for extreme operating conditions.

Ordering example

Mönninghoff electromagnetic multiple-disc clutch
Type 502.21.1.1

Operating mode	dry running
Voltage	24 Vdc
Bore size d	30 mm H7, keyway acc to. DIN 6885/1



Electromagnetic multiple-disc clutch - Type 502

Clutch size

The selection of the correct size of a Mönninghoff electromagnetic multiple-disc clutch is determined by the requiered torque as well as the shift work.

- According to the required torque

$$M_S \geq M_{erf}$$

- According to the shift work

$$E_h \leq Q_h$$

The clutch must transfer load and acceleration torque (M_L; M_b). The required safety is obtained by using a corresponding safety factor (K).

$$M_{erf} = (M_b \pm M_L) \cdot K$$

$$M_b = \frac{I \cdot \Delta n}{9{,}55 \cdot t} \quad [Nm]$$

$$Q_h = Q \cdot k_1 \cdot k_2 \quad [Nm]$$

$$E_h = \frac{I \cdot (\Delta n)^2 \cdot Z}{182{,}4} \quad [Nm]$$

If the load and acceleration torque cannot be determined, the required torque can be derived from the driving power, taking the required safety into cosideration.

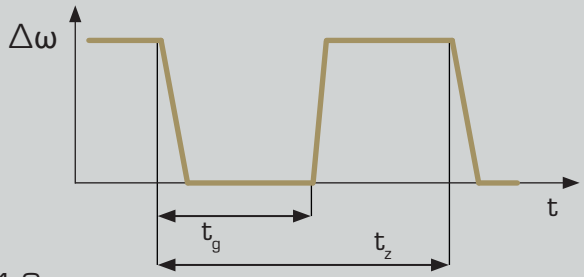
$$M_{erf} = 9550 \cdot \frac{P}{n} \cdot K \quad [Nm]$$

M_{erf}	= required torque	P	= driving power [kW]
M_b	= acceleration torque	K	= safety factor [1,2 to 4]
M_s	= shift torque	I	= moment of inertia [kgm²]
M_L	= output load torque	Z	= number of shift operations per hour
n	= speed of rotations [min⁻¹]	Q	= amount of heat
Δn	= differential speed of rotations [min⁻¹]	E_h	= shift energy per hour [Nm]
k_1	= correction factor	t	= acceleration time [sec]
k_2	= correction factor		based on t_1

Electromagnetic multiple-disc clutch - Type 502

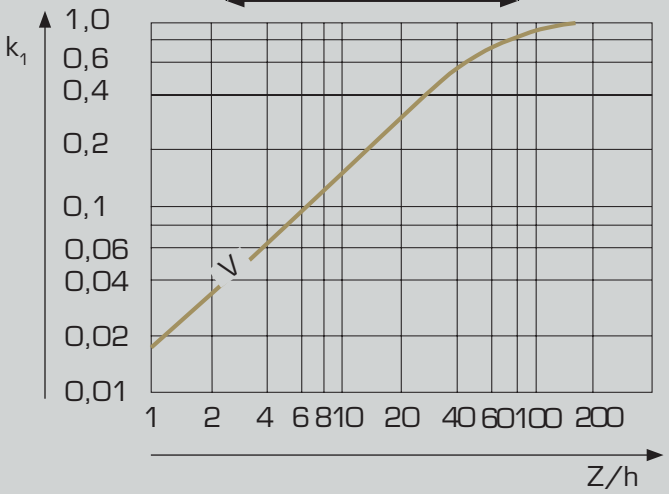
Determination of shift work

The energy that is lost in the clutch depends on the shift curve and the shift frequency. The correction factors for the permissible shift work per hour Q_h can be derived from the tables and graphs.

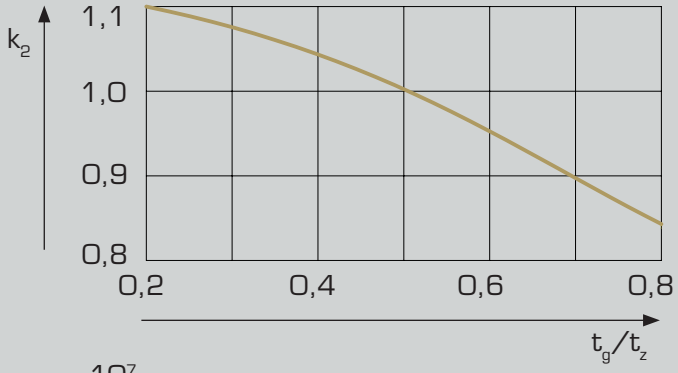


Course of a shift cycle

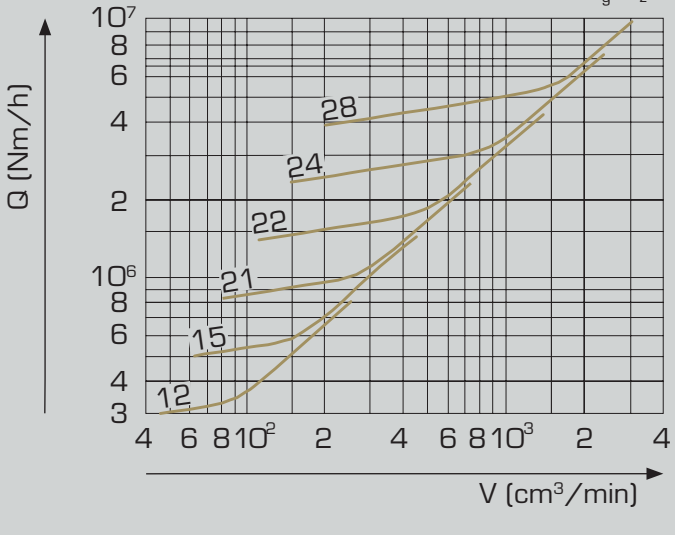
t_g = time during which the clutch is closed
t_z = total cycle time
Δω = differential angular velocity



Correction factor k_1 as a function of the shift frequency per hour
V valid for all sizes and types of clutches whose discs are surrounded by the field of force



Correction factor k_2 as function t_g/t_z



Amount of heat Q as function of the amount of cooling oil; valid for clutches whose discs are surrounded by the field of force

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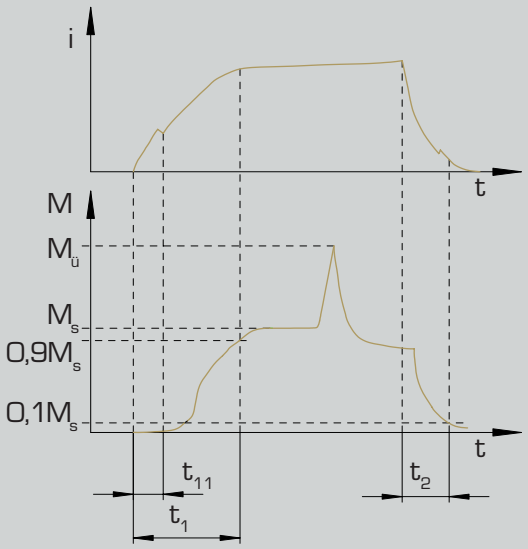
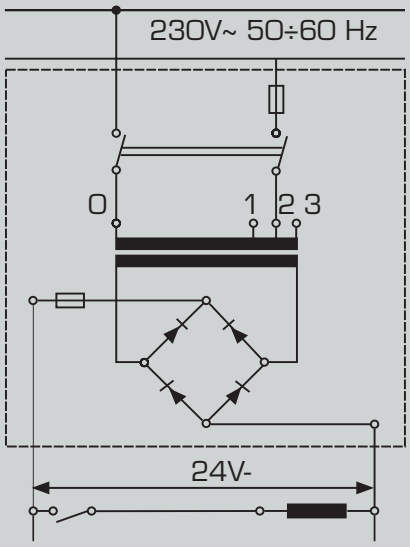
Electromagnetic multiple-disc clutch - Type 502

Switching

Electromagnetic clutches are inductances. Engagement and disengagement are subject to the laws of induction, i. e. the induction current increases according to an e-function.



Shift speeds



Shift diagram: normal shifting

- t_1 and t_2 can be electrically influenced by taking appropriate measures
- it is advisable to use direct current for shifting
- when determining the size, the engage time is considered to be approximately 30% of the total acceleration time, which normally results in additional safety

Technical data

Size			16	21	22	24	26	28	
shift speeds acc. to VDE 0580:2011-11	t_1	[msec]	220/140	250/160	360/250	450/330	600/450	900/600	normal excitation (fast excitation 3 times)
	t_2		70/60	90/80	110/100	200/180	250/220	400/350s	

i = induction current

$M_Ü$ = torque to be transferred / static torque

M_S = torque to be shifted

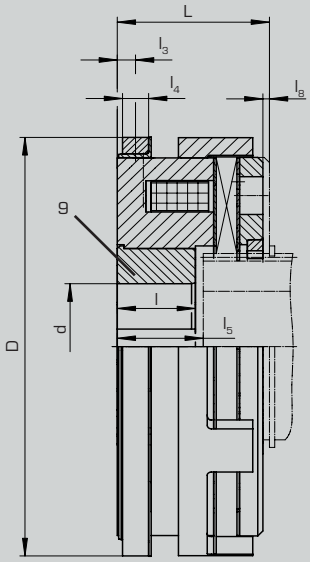
t_1 = engage time

t_2 = disengage time

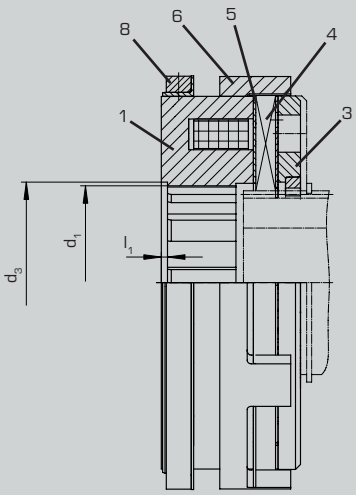
t_{11} = response delay

Electromagnetic multiple-disc clutch - Type 502

Clutch size



Type 1: with hub

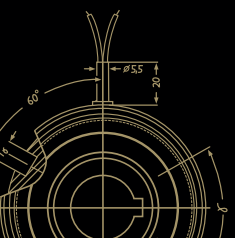


Type 1: without hub

1 Coilbody
3 Armature
4 Inner plate
5 Outer plate
6 Drive ring
8 Slip ring
9 Hub

Technical data

Size				12	15	21	22	24	28
torque		$M_s$dyn	[Nm]	25	60	120	250	480	960
max. speed			[min^{-1}]	3000	3000	2400	2000	2000	2000
input power			[W]	18	30	30	45	66	88
inertia	parts 1, 5, 6, 8, 9		[$10^{-3}kgm^2$]	1,1	3,0	6,8	16,8	39	93
	parts 3, 4			0,18	0,5	1,45	4,8	11	34
weight			[kg]	1,25	2,25	4	6,4	10,5	18
number of plates	inner plate			4	5	5	5	6	6
	outer plate			4	5	5	5	6	6
min. bore	keyway acc. to DIN 6885/1	d H7	[mm]	15	20	25	30	35	50
max. bore				25	32	38	52	62	75
number of keyways in the hub				1	1	2 x 180	2 x 180	4 x 90	4 x 90
multikeyway	DIN 5462	d_1		8 x 36	8 x 46	8 x 52	10 x 72	10 x 82	10 x 102
				8 x 40	8 x 50	8 x 58	10 x 78	10 x 88	10 x 108
dimensions		D	[mm]	95	114	134	166	195	240
		d_1 H7		36	46	52	72	82	102
		d_3 H9		42	52	60	80	90	110
		L		36	45,5	52	58,5	68,5	77
		l -0,1		20	23	26	30	33,5	37
		l_1		1,5	2	2	2,5	3	3
		l_3		5,5	6	7	7	7	8,5
		l_4		8	8	10	10	10	10
		l_5		23	26	29	33	36,5	40
		l_8		1,2	1,8	2	2,5	3,5	5



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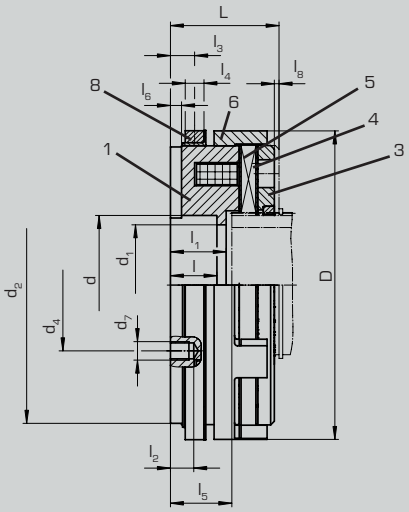
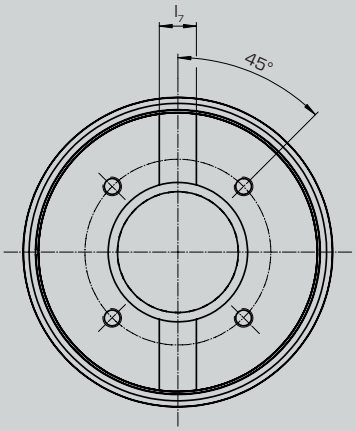
Electromagnetic multiple-disc clutch - Type 502

Clutch size



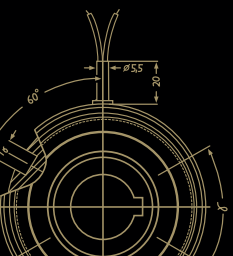


1 Coilbody
3 Armature
4 Inner plate
5 Outer plate
6 Drive ring
8 Slipring

Type 3

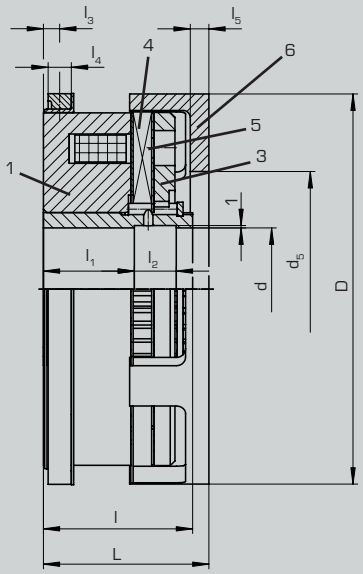
Technical data

Size				12	15	21	22	24	28
torque		$M_s$dyn	[Nm]	25	60	120	250	480	960
max. speed			[min^{-1}]	3000	3000	2400	2000	2000	2000
input power			[W]	18	30	30	45	66	88
inertia	parts 1, 5, 6, 8		[$10^{-3}kgm^2$]	1,5	3,7	7,23	19,3	40	95
	parts 3, 4			0,18	0,5	1,45	4,8	11	34
weight			[kg]	1,2	2	3,5	6,5	9,3	16,7
number of plates	inner plate			4	5	5	5	6	6
	outer plate			4	5	5	5	6	6
dimensions		D	[mm]	95	114	134	166	195	240
		d K6		42	55	68	75	90	110
		d_1		37	45	60	65	80	100
		d_2		85,5	95	120	150	178	218
		d_4		56	75	90	100	116	145
		d_7		M6	M8	M8	M10	M10	M12
		L		38	49,5	55	58,5	69	80
		l +0,2		20	22	22	25	28	32
		l_1		22	27	29	30	34	40
		l_2		5	8	8	10	12	18
		l_3		7,5	11	11	13	13	14,5
		l_4		8	8	10	10	10	10
		l_5		25	30	32	33	37	43
		l_6 +0,1		2,5	5	5	6	6	6
		l_7 H7		12	14	16	20	20	25
		l_8		1,2	1,8	2	2,5	3,5	5



Electromagnetic multiple-disc clutch - Type 502

Clutch size

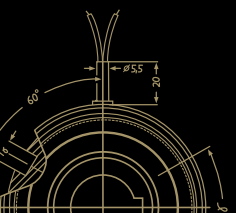


1 Coilbody
3 Armature
4 Inner plate
5 Outer plate
6 Drive ring

Type 4

Technical data

Size				12	15	21	22	24	28
torque		$M_s$dyn	[Nm]	25	60	120	250	480	960
		M_s stat		40	100	200	400	800	1600
max. speed			[min^{-1}]	3000	3000	2400	2000	2000	2000
input power			[W]	18	30	30	45	66	88
inertia	parts 1, 3, 4		[10^{-3}kgm^2]	1,2	3,2	7,4	20,5	48	117
	parts 5, 6			0,5	1,6	3	7	14,5	50
weight			[kg]	1,5	2,6	4,5	7,8	13,7	26,5
number of plates	inner plates			5	6	6	6	7	7
	outer plates			4	5	5	5	6	6
min. bore	keyway acc. to DIN 6885/1	d H7	[mm]	15	20	25	30	35	50
max. bore				25	32	40	50	60	75
dimensions		D	[mm]	95	114	134	166	195	240
		d_5 H7		45	51	61	75	90	112
		L		46	55	61,5	71	85	90
		l -0,1		41	49	56	64	76	80
		l_1		31	29	32	39	43	42
		l_2		10	14	14	18	20	20
		l_3		6	6	7	7	7	8,5
		l_4		8	8	10	10	10	10
		l_5		5	6	6	8	9	10



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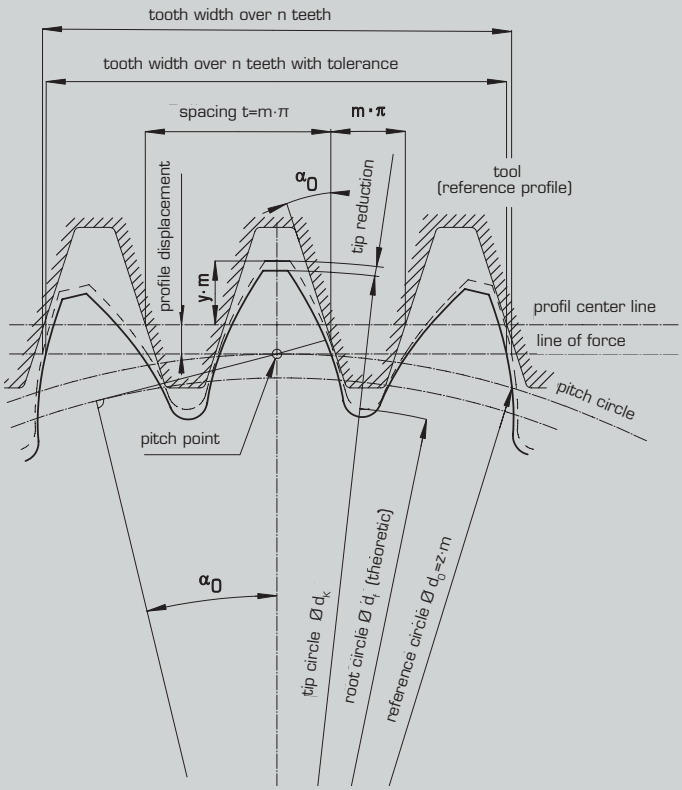
Electromagnetic multiple-disc clutch - Type 502

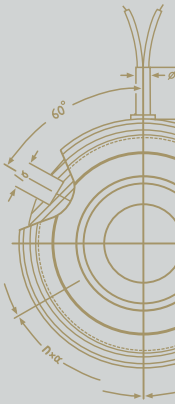
Inner driver



Gear specifications acc. to DIN 867

Index 1: design 1, 2 and 4 possesse 28 teeths
Index 2: design 3 possesses 31 teeths

- the surface hardness of the driver is 59 - 62 HRc
- case depth can vary from 0,2 to 0,6 mm



z = number of teeth
m = module
d_0 = reference diameter (= z·m)
d_k = outside diameter
d_f = root diameter
α_0 = pressure angle (= 20°)

Technical data

Size			12	15	21	21	22	24	28
index					1	2			
number of teeth	z		27	27	28	31	27	33	42
module	m		1,5	1,75	2	2	2,5	2,5	2,5
outside diameter	$d_{k-0,2}$	[mm]	43,3	50,5	60,5	66,4	73,2	88,2	110,0
root diameter	d_f	[mm]	37,65	43,96	52,64	58,68	63,40	78,40	98,15
tooth width	$Wn_{0,06}$	[mm]	16,37	19,11	22,01	22,10	27,51	27,72	34,48
number of measuring teeth over "n" teeth			4	4	4	4	4	4	5
profile displacement	x	[mm]	+0,3	+0,31	+0,41	+0,42	+0,43	+0,43	-0,12
tooth length	l_{zmin}	[mm]	12	18,5	21,5	21,5	23,5	30	33,0

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Electromagnetic multiple-disc clutch - Type 502

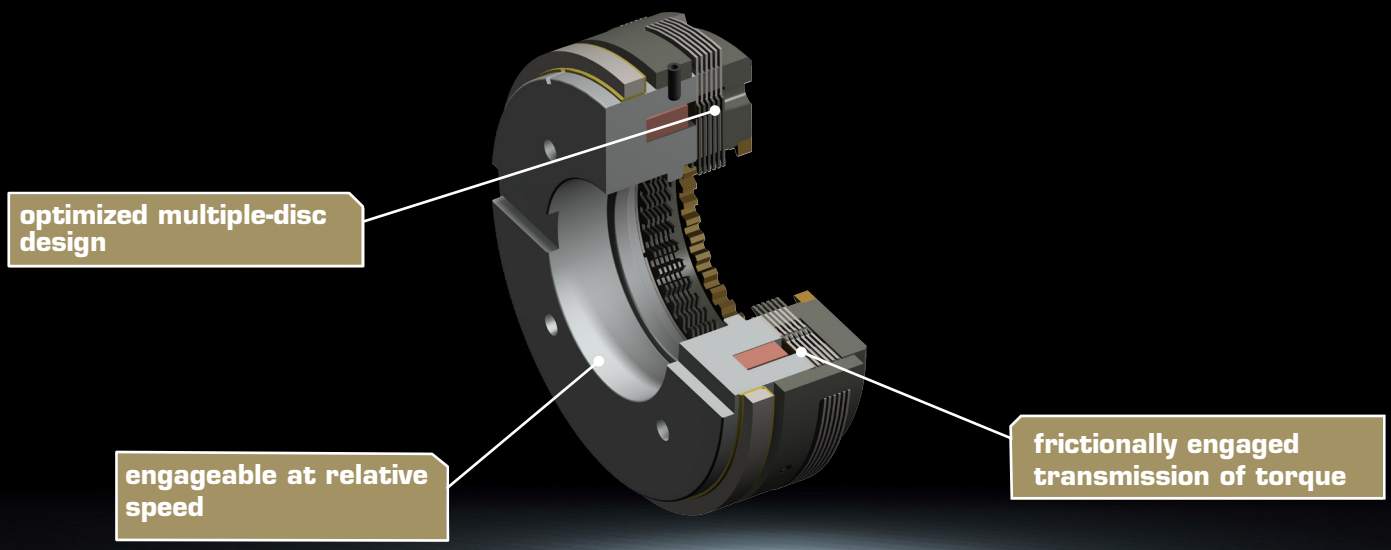
Voltage

- standard voltage is 24 Vdc dirrect current
- special voltages as a example 48 Vdc on request

Technical characteristic

- must run in oil
- the arrangement of the discs between the pole faces and the armature requires the discs to be made of a ferromagnetic material with good friction and wear properties, which are obtained by hardening and nitriding
- residual magentism resulting from the hardening process is eliminated by the special design of the discs
- the shape of the discs prevents the oil from building up when the temperature drops, thus avoiding shift delays
- clutches whose discs are surrounded by the field of force are paritculary suitable for shifting operations with a high energy exchange
- require no maintenance

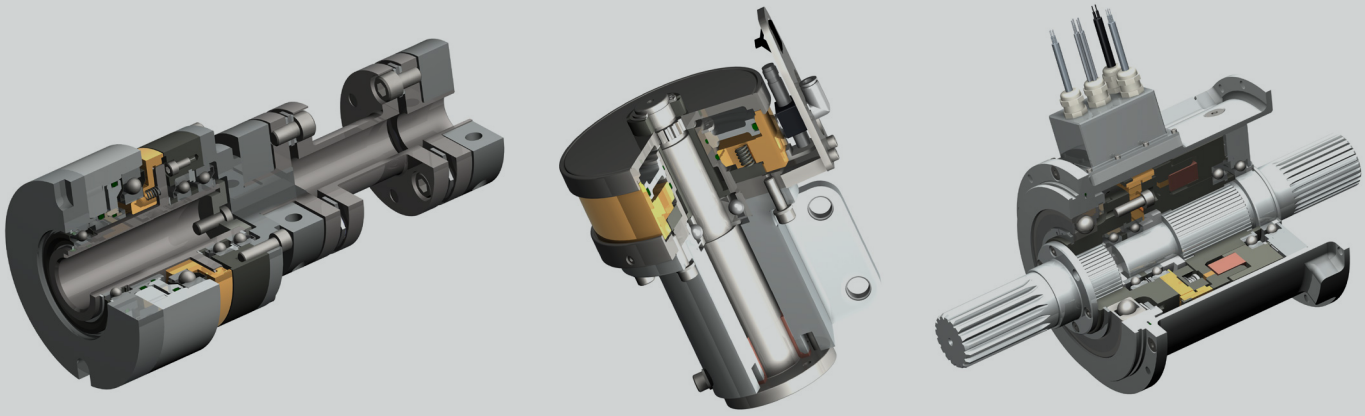
At a glance



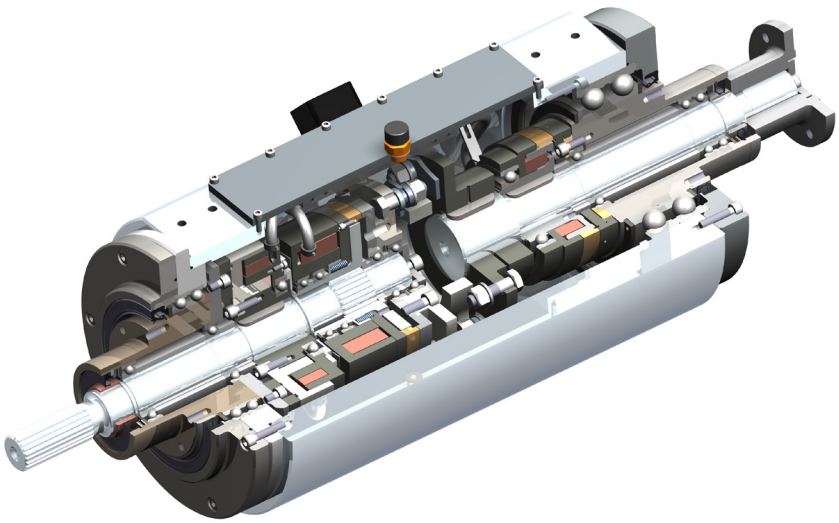
System solutions

You need more?

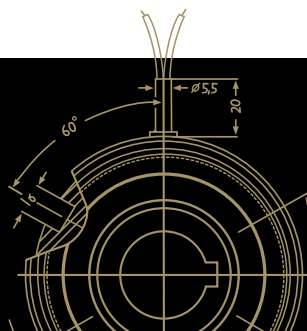
Mönninghoff clutches can be combined with a variety of many other power transmission elements. Such complex high-tech systems can solve any application-specific tasks and can fulfill any customer-specific wishes.



In many cases, a combination of different drive elements is needed to solve the applications particular problems and difficulties. Being not just supplier but technological partner to our customers, our extensive engineering is part of extraordinary and challenging power transmission projects.



Our product is the know-how,
with hardware as an added bonus.



Mönninghoff

Driven by excellence

Why Mönninghoff

- intensive dialog with our customers‘ engineers
- decades of experience and competence
- deep understanding for all areas of mechanical engineering
- highly modern and flexible machine park
- enthusiasm for quality
- flexibility, inventiveness and communication skills of our employees
- commitment to Germany and Bochum as industrial location

Helps you find a customer-specific power transmission solution for extraordinary circumstances.

For the competent processing and smooth handling of your orders and delivery dates.

Feels committed to protect and preserve the high value of your machine and to secure its availability.

CHAIN & DRIVES®

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